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United States Department of Agriculture,

DIVISION OF ENTOMOLOGY.

MOSQUITOES AND FLEAS.

I.—MOSQUITOES.

We are accustomed to think of but a single species of mosquito, and of this as occurring in most parts of the country, but as a matter of fact, thirty species are known to inhabit the United States.

The following statement concerning the life history of these insects is based upon a series of observations made in this Division upon the development of two summer generations of *Culex pungens*, one of our commonest and most widespread species. The writer has seen specimens of this insect from New Hampshire, Massachusetts, New York, Maryland, District of Columbia, Illinois, Minnesota, Kentucky, Nebraska, Texas, Louisiana, Georgia, and the Island of Jamaica, West Indies. No doubt it is also abundant in New Jersey.

Egg-laying takes place at night. The eggs are deposited in boat-shaped masses on the surface of the water, the number varying from 200 to 400 in each mass. The eggs may hatch in sixteen hours. The larvæ live beneath the surface of the water, coming to the top at frequent intervals to breathe. The larval state may be completed in seven days; the pupal state may last only twenty-four hours. An entire generation in summer time, then, may be completed in ten days. This length of time, however, may be almost indefinitely enlarged if the weather be cool. There are, therefore, many generations in the course of a season and the insect may breed successfully in a more or less transient surface pool of water.

Mosquitoes hibernate in the adult condition in cellars and outhouses and under all sorts of shelter. The degree of cold makes no difference in successful hibernation; mosquitoes are abundant in the arctic regions.

REMEDIES.

Of remedies against mosquitoes in houses the best is a thorough screening of windows and the placing of nets about beds. If the insects are troublesome in sitting or sleeping rooms during the evening, the burning of pyrethrum will so stupefy them as to make their presence unobjectionable. Pyrethrum for this purpose should be prepared by moistening the powder sufficiently to allow of its being roughly molded by hand into little cones about the size and shape of a large chocolate drop. These cones are then placed in a pan and

thoroughly dried in an oven. When fired at the apex, such a cone will smoulder slowly, and send up a thin column of pungent smoke, not hurtful to man, but stupefying to mosquitoes. In actual experience two or three cones burned during the course of an evening have given much relief from mosquitoes in sitting rooms. It does not always kill the insects, however, and is at best a palliative.

The mosquitoes found on the ceilings of bedrooms in the evenings may be quickly and easily killed by means of a small, shallow tin cup (such as the lid of a blacking box) nailed to the top of a stick and wet inside with kerosene. This cup is placed over the quiescent mosquito, which immediately drops or flies against the oily surface and is killed. But altogether the most satisfactory means of fighting mosquitoes are those which are directed to the destruction of the larvæ or the abolition of breeding places. These measures are not everywhere feasible, but in many places there is absolutely no necessity for the endurance of the mosquito plague. The principal remedies of this class are three: The draining of ponds and marshes, the introduction of fish into fishless ponds, and the use of kerosene on the surface of the water.

The draining of breeding pools needs no discussion. Obviously the drying up of such places will prevent mosquitoes from breeding therein, and the conditions of a successful application of this measure will, it is equally obvious, vary with each case.

The introduction of fish into fishless ponds is feasible and advisable in many cases where the use of kerosene on the surface of the water would be thought undesirable. In tanks supplying drinking water, for example, fish would destroy the mosquito larvæ as fast as hatched. A case is recorded in Insect Life (Vol. IV, p. 223) where carp were employed in this way with perfect success by an English gentleman living in the Riviera. At San Diego, Tex., the people use for this purpose a little fish, called there a perch, the species of which the writer has not been able to ascertain. Probably the common voracious little stickle-back would answer admirably as a mosquito destroyer.

Probably the best, and certainly the easiest, of wholesale remedies against mosquitoes is the application of kerosene to the surface of breeding pools. The suggestion that kerosene could be used as a remedy for mosquitoes is not new and has been made more than once. Exact experiments out of doors and on a large scale were made in 1892 by the writer. These and subsequent experiments show that approximately 1 ounce of kerosene to each 15 feet of water surface on small pools will effectually destroy all the larvæ and pupæ in that pool, with the additional advantage that the adult females, not deterred from attempting to oviposit, are killed when they alight on the kerosene-covered water. Ordinarily the application need not be renewed for a month, though varying circumstances may require more frequent applications in certain cases.

Since 1892 several demonstrations, on large and small scales, have been made of the practicability of this method. Under the writer's supervision two localities were rid of mosquitoes by the use of kerosene alone. It will, however, probably not prove feasible to treat in this way the large sea marshes along the coast where mosquitoes breed in hordes, although even here the remedy may prove to be practicable under certain circumstances and in certain situations. In inland places, however, where the mosquito supply is derived from comparatively circumscribed pools, the kerosene remedy will prove most useful. In some California towns, we are informed, the pit or vault behind water-closets is subject to flushing with water during the irrigation of the land nearby. A period of several weeks elapses before more water is turned in, and in the meantime the water in the pit grows stagnant and becomes the breeding place of thousands of mosquitoes. Where, as in certain towns and cities, house drainage runs into such a pit and an outdoor privy with a seldom closed door is built over it, mosquitoes will breed all summer in the fluid contents of the vault and of course will infest all the adjacent houses.

In such cases a teacupful of kerosene poured into each vault at intervals of a month or less would greatly decrease the annoyance from mosquitoes, if it did not altogether prevent it. This is a case where the cooperation of neighbors is most desirable. Every householder in a given neighborhood should see that his vault is treated with kerosene regularly and often. The cost is so trifling that it need not be considered.

Where, as is the case at many country homes, rain water is collected in barrels or hogsheads, for one purpose or another, mosquitoes may and do breed in numbers in such vessels. If the water as used be drawn from the bottom of the cask it will do no harm to pour in a little kerosene, since the oil will not be drawn out with the water. At all events, such receptacles should be covered at night and on cloudy days to prevent egg-laying.

The question, What is the best way to cover with kerosene the surface of a pool of some size is apparently needless, since the operation is obviously simple, but such a question has been asked of the Division. Simply pouring the oil on from any point of the shore will answer tolerably well, since it will spread of itself, but if for any reason it is desired to coat the pool rapidly with kerosene, it may be advisable to spray the oil through a spraying nozzle, either from the bank or from a boat. The method of application will vary with each case, but in the class of pools which can be most advantageously treated, namely, those of small size, the oil can be well spread by throwing it on to windward with a wide sweep of the arm.

II.—FLEAS.

Judging from the specimens of fleas sent to the Division of late years, with complaints of houses infested by them, the human flea (*Pulex irritans*) is not the species most likely to occur in great numbers in dwelling houses, but rather the common cosmopolitan flea of the dog and cat (*Pulex serraticeps*). A house may become infested with this species, even though no domestic animals be kept, for a visitor at a house where such pets are maintained may be the means of carrying home with him one or two female fleas which will stock his own premises. Of course where a pet dog or cat is kept the source of the infestation is manifest.

The worst cases of infestation reported to this Division were where houses had been temporarily unoccupied during the summer. Such houses often become more or less damp, and as a rule the customary sweeping of the floors is interrupted, thus furnishing the very conditions under which, as we shall see, fleas most readily propagate.

The eggs of *Pulex serraticeps* are deposited among the hairs of cats and dogs, but as they are not attached to the hairs, numbers drop off whenever the infested animal moves or lies down. For experimenters who desire to follow out for themselves the life history of the species, an easy way to collect the eggs is therefore to lay a strip of cloth or carpet for the animal to sleep upon, and afterwards to brush the cloth into a receptacle, in which the eggs will be found in numbers if the animal is infested. In this lies a hint for the housekeeper who would keep a pet dog or cat and yet avoid an outbreak of fleas in the house. Provide a rug for the cat or the dog to sleep on and give this rug a frequent shaking and brushing, afterwards, sweeping up and burning the dust thus removed. As all the flea eggs on an infested animal will not, however, drop off in this way, and those which remain on it will probably develop successfully, it will be found wise to occasionally rub into the hair of the dog or cat a quantity of pyrethrum powder. If thoroughly applied it will cause the fleas to fall off in a half stupefied condition, when they, too, may be swept up and burned.

In the observations made at this Department upon this species of flea during the summer of 1895, some difficulty was found in preserving just the right degree of moisture to enable the insect successfully to transform. An excess of moisture was found prejudicial to the development of the species, as was too great dryness. The observations showed, however, that at Washington in summer an entire generation may develop in a little more than a fortnight. Hence a housekeeper shutting up her house in June, for example, with a colony of fleas too small to be noticed inside it need not be surprised to find the establishment overrun when she opens it up again in September or October.

REMEDIES.

The larvæ of the dog and cat flea will not develop successfully in situations where they are likely to be disturbed. The use of carpets and straw mattings, in our opinion, favors their development, since the young larvæ can penetrate the interstices of either sort of floor-covering and find an abiding place in some crack where they are not likely to be disturbed. It is comparatively easy to destroy the insect in its early stages (when it is noticed), as is shown by the difficulty of rearing it, but the adult fleas are so active and so hardy that they successfully resist any but the most strenuous measures. Even the persistent use of California buhach and other pyrethrum powders was ineffectual in one case of extreme infestation, as was also, and more remarkably, a free sprinkling of floor mattings with benzine. In this instance it was finally necessary to take up the floor coverings and wash the floors down with hot soapsuds in order to secure relief from the flea plague. In another case, however, a single liberal application of buhach was perfectly successful, while in a third a single thorough application of benzine completely rid an infested house of fleas.

To sum up: Every house where a pet dog or cat is kept may become seriously infested with fleas if the proper conditions of moisture and freedom from disturbance exist. Infestation, however, is not likely to occur if the (bare) floors can be frequently and thoroughly swept. When an outbreak of fleas comes, however, the easiest remedy to apply is a free sprinkling of pyrethrum powder in the infested rooms. This failing, benzine may be tried, a thorough spraying of carpets and floors being undertaken, with the exercise of due precaution in seeing that no lights or fires are in the house at the time of the application, or for some hours afterwards. Finally, if the plague is not thus abated, all floor coverings must be removed and the floors washed with hot soapsuds. This is a useful precaution to take in any house which it is proposed to close for the summer, since even a thorough sweeping may leave behind some few flea eggs from which an all-pervading swarm may develop before the house is reopened.

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Approved:
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